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(54) Electrotherapeutic apparatus for effecting iontophoresis

(57) Apparatus for promoting growth and regeneration of eyebrows comprises an active electrode 1 for application to the eyebrow and a dispersive electrode 3. A plate member 5 supports the active and dispersive electrodes, and a flexible belt 7 is attached to both ends of the plate member and enables the apparatus to be fitted to the patient's head. An oscillator (O) is arranged to generate an electrotherapeutic current having a diphasic alternating potential superimposed on a pulsating current. A dc source (B) supplies the apparatus such that the active and dispersive electrodes are energized by the electrotherapeutic current such that the potential at the active electrode is sufficiently higher than that at the dispersive electrode to effect iontophoresis of an aminovinyl photosensitizing dye.

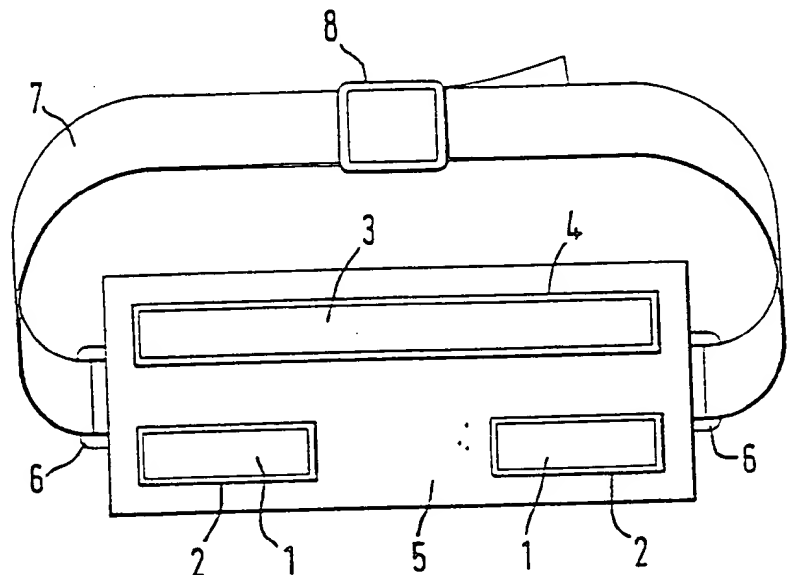


FIG.1

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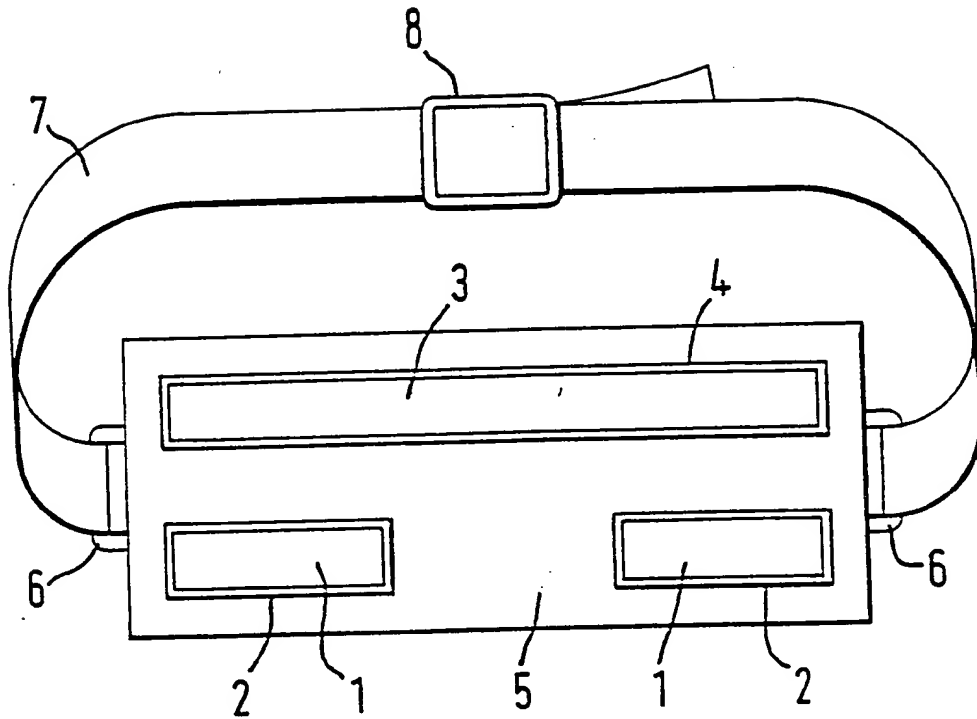


FIG. 1

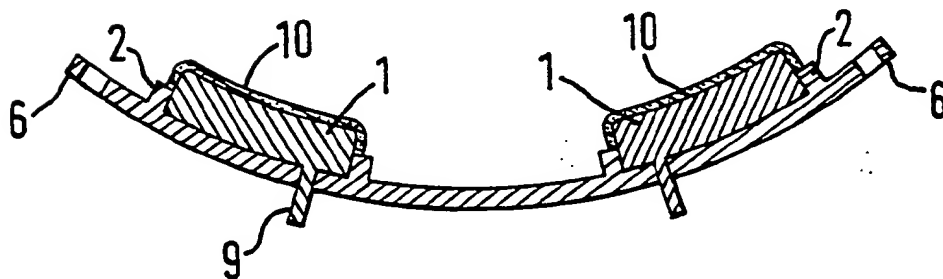


FIG. 2

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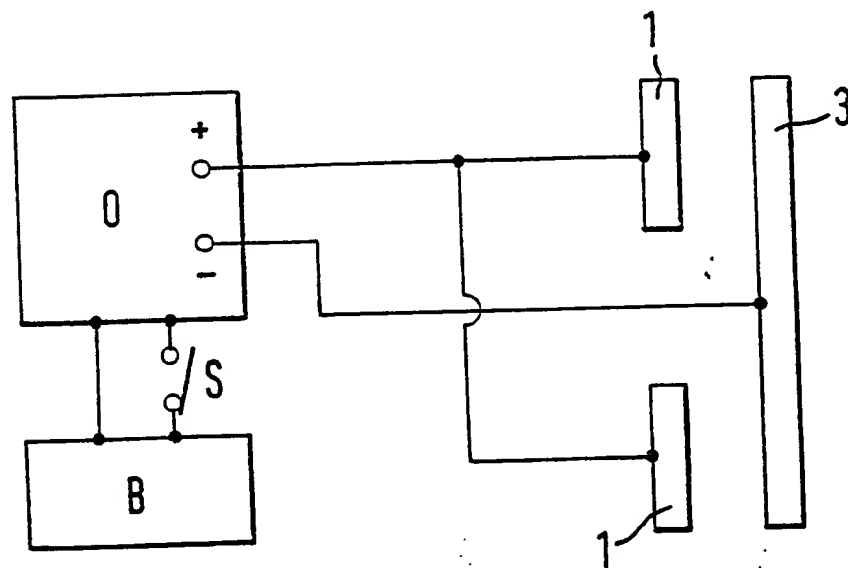
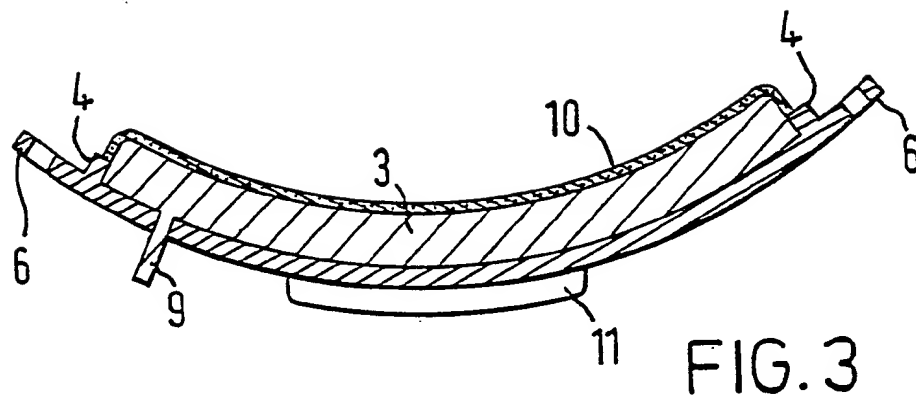
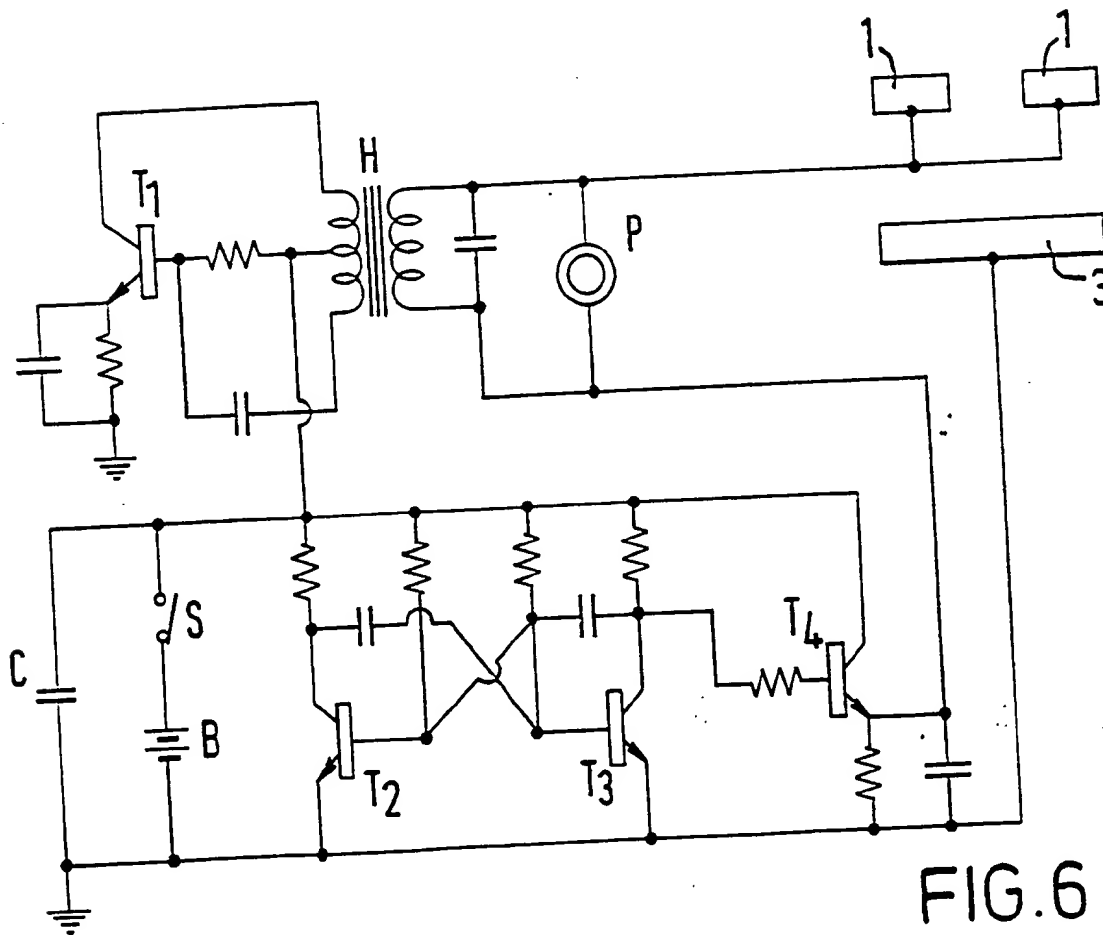
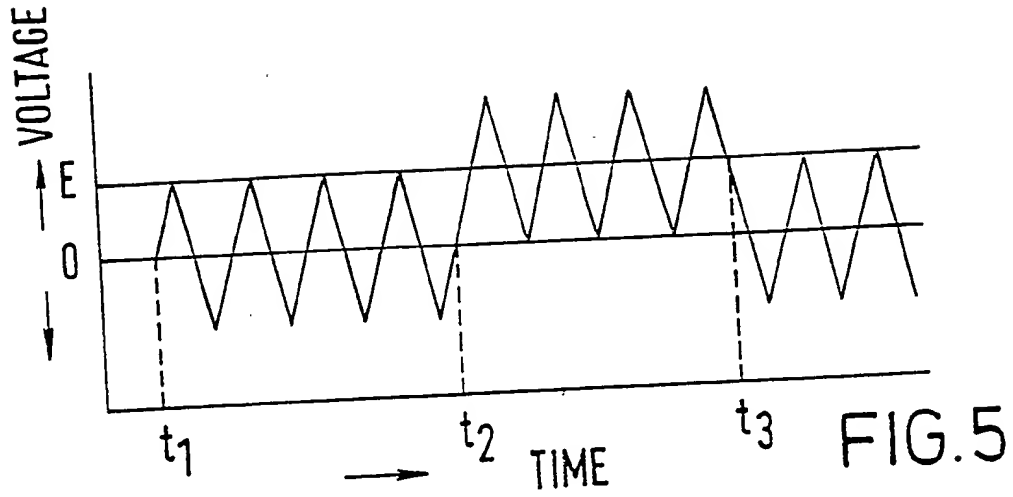


FIG. 4

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SPECIFICATION

Electrotherapeutic Apparatus for Effecting Iontophoresis

The present invention relates to an
5 electrotherapeutic apparatus, for example, to an electrotherapeutic apparatus for promoting the growth and regeneration of eyebrows by iontophoresis.

Although several methods in which medicaments
10 are applied to eyebrows to promote growth and regeneration are known, the efficacies of these methods have proved unsatisfactory. No electrotherapeutic method, specifically, no iontophoretic method has been attempted for such
15 purpose.

It has been disclosed that a remarkably high growth effect can be attained by iontophoresis of a certain aminovinyl photosensitizing dye using an electrotherapeutic current obtained by
20 superposition of a diphasic action potential-like wave on a pulsatile current, both having a prescribed frequency. This electrotherapy is disclosed in Japan Patent Kokai No. 221,957/83 together with an apparatus for applying the
25 electrotherapy.

For one dose of this electrotherapy, the electrotherapeutic current is applied for a relatively long duration, for example, for thirty minutes, or preferably for one hour or longer. The
30 electrotherapeutic apparatus as disclosed in Japan Patent Kokai No. 221,957/83 has the disadvantage that the patient must hold the apparatus throughout the electrotherapy, which is painful and inconvenient, particularly if the apparatus has to be
35 held in place for a long duration. Thus, the conventional apparatus does not give a satisfactory treatment.

It is an object of the present invention to reduce the disadvantages of the conventional
40 electrotherapeutic apparatus.

It is also an object of the present invention to provide an electrotherapeutic apparatus specifically for promoting the growth and regeneration of the eyebrow.

According to the present invention there is provided an electrotherapeutic apparatus,
45 comprising:

- (a) an active electrode;
- (b) a dispersive electrode;
- 50 (c) a single plate member supporting said active and dispersive electrodes;
- (d) a flexible belt attached to both ends of the plate member,
- (e) an oscillator generating an electrotherapeutic
55 current having a diphasic alternating potential superposed on a pulsating current; and
- (f) a dc source for supplying the apparatus, wherein said active and dispersive electrodes are energized by said electrotherapeutic current such
60 that the potential at the active electrode is sufficiently higher than that at the dispersive electrode that iontophoresis of an aminovinyl photosensitizing dye is effected.

Preferably the or each active electrode

65 substantially conforms in shape to that of an eyebrow, and the dispersive electrode is wide-shaped.

Embodiments of the present invention will hereinafter be described, by way of example, with
70 reference to the accompanying drawings, in which:—

Figure 1 shows an apparatus of the invention in elevation;

Figure 2 shows a transverse section taken through active electrodes of the apparatus of Figure 1;

75 Figure 3 shows a transverse section taken through a dispersive electrode of the apparatus of Figure 1;

Figure 4 shows a block circuit diagram of an apparatus as shown in Figure 1;

80 Figure 5 shows the waveform of a superposed current used in apparatus of the invention; and

Figure 6 shows the circuit of an oscillator of apparatus of the invention.

In the accompanying drawings, reference 1
85 designates an active electrode; 2 is a frame for supporting an active electrode 1; 3 is a dispersive electrode; 4 is a frame for supporting a dispersive electrode 3; 5 is a support plate; 6 is engaging means; 7 is a flexible belt; 8 is fixing means; 9 is a
90 terminal; 10 is a moisture-retaining material; 11 is a housing; T is a transistor; H is a transformer; P is an earphone; C is a capacitance; S is a switch; B is a battery; and O is an oscillator.

The apparatus illustrated in Figures 1 to 3
95 comprises two active electrodes 1 each fitted in a respective frame 2, and a dispersive electrode 3 fitted into a frame 4. The frames 2 and 4 are all provided on a plate member 5. The electrodes 1 and 3 are preferably made of stainless steel and their
100 surfaces are covered with moisture-retaining material 10, for example, sponge. When, as is the case when treating only one eyebrow, energization of both active electrodes 1 is unnecessary, one of these active electrodes may be suitably insulated
105 from the patient's skin, or connection of the electrodes may be temporarily changed so that a superposed current energizes one or the other of the active electrodes.

As shown in Figures 2 and 3, the plate member 5
110 carries the active and dispersive electrodes 1, 3, and forms a generally curved single body. The surface of the plate member 5 facing the patient's skin is concave. A flexible belt 7 is attached to both ends of the plate member 5 by way of engaging means 6 to
115 thereby form, for example, a headband. Fixing means 8 may be provided to enable length of the flexible belt 7 to be adjusted.

As shown in Figure 3, a housing 11 may be provided on the side of the plate member 5 facing away from the patient's skin. An oscillator O and a battery B (Figure 4) may be received within the housing 11. Each of the active and dispersive
120 electrodes 1, 3 is provided with a respective terminal 9 which is then electrically connected in to circuit
125 with the oscillator O and the battery B. As shown in Figure 4, the output of the oscillator O is connected to the active and dispersive electrodes 1, 3 such that the potential at the active electrode 1 is higher than that at the dispersive electrode 3. This enables the

electrodes to electrically repel a positively charged aminovinyl photosensitizing dye into the deeper portion of the patient's eyebrow.

- Fig. 5 shows the output waveform of the oscillator
- 5 O. The output is a diphasic action wave which alternates during a time period from t_1 to t_2 about the zero volt line, and, during a time period from t_2 to t_3 , at a positive voltage E. Over the period t_2 to t_3 , the active electrode 1 is energized with the positive
- 10 dc voltage E to strongly introduce an aminovinyl photosensitizing dye into the deeper portion of the eyebrow to promote its growth and regeneration. During the period of t_1 to t_2 , the positive dc voltage massages the affected part and neighbouring tissue
- 15 with electricity, as well as cancelling the electrolysis arising at the affected part to prevent burn. Preferably, the period t_1 to t_2 is set to equal the period t_2 to t_3 , and for example, to be in the range 0.5—2 seconds, and the positive dc voltage E is set
- 20 to be in the range 1—20 volts.

- Fig. 6 shows an oscillator circuit which can be used in apparatus of the invention. In the illustrated oscillator circuit a blocking oscillator and a
- 25 multivibrator are combined. The blocking oscillator includes transistor T_1 and is arranged to oscillate to produce a diphasic action alternating potential having a frequency of 1/500—1/200 seconds. The multivibrator includes transistors T_2 and T_3 and produces a pulsating current, such as a square or a
- 30 trapezoidal wave, with a frequency of 0.5—2 seconds. The output of the multivibrator is applied to the secondary coil of a transformer H by way of an emitter follower circuit including a transistor T_4 and is then superimposed on the pulsating current
- 35 generated by the blocking oscillator. In this manner an alternating current is applied to the electrodes 1 and 3 which has been obtained by superimposing the diphasic alternating potential on the pulsating current. The alternating current can be
- 40 advantageously used for iontophoresis of an aminovinyl photosensitizing dye.

- An earphone P is connected in parallel with the secondary coil of the transformer H and can be used to listen to the sound of the waveform applied to the
- 45 active electrode 1. The earphone P may be combined with a light emitting diode. A capacitance C is connected in parallel with the battery B to balance the internal resistance of the battery B.

- The following is illustrative of a method for using
- 50 apparatus of the invention.

- An aminovinyl photosensitizing dye effective for the growth and regeneration of the eyebrow, for example, 6 - [2 - [(5 - bromo - 2 - pyridyl)amino]vinyl] - 1 - ethyl - 2 - picolinium
- 55 iodide, commercialized by Nippon Kankho-Shikiso Kenkyusho Co., Ltd., Okayama, Japan, under the trade name of "Kankhoo-so No. 301", is first dissolved in an aqueous alcohol to give a concentration of about 10—1,000 ppm. The
- 60 resultant solution is then either applied to the eyebrow to be treated, or absorbed in the moisture retaining material 10 covering the active electrodes 1. The apparatus is then fitted onto the patient's head so that the active electrodes are pressed onto

- pressed onto another facial part, such as the forehead of the patient. The electrodes are then energized by a superposed current to effect iontophoresis of the aminovinyl photosensitizing dye into the deep portion of the eyebrow. The superposed current is preferably applied at a voltage of between 1—50 volts, for example, 5—20 volts, in a dose between 0.1—10 milliamperes, preferably 1—5 milliamperes, for about 5—60
- 70 minutes. Preferably, the treatment is applied for a net 30 minutes, allowing the patient to rest at intervals of about 10 minutes. The treatment can be repeated until the expected result has been achieved whilst observing the state of the affected
- 80 part.

Long-term electrotherapy free of painful handling can be carried out with apparatus of the invention because the apparatus is fitted onto the patient's head during the electrotherapy.

- 85 Of course, electrotherapy using the apparatus can be carried out in combination with conventional chemotherapeutic and/or treatment for alopecia, if necessary.

- For these reasons, the apparatus described can
- 90 also be advantageously used to promote the growth and regeneration of the eyebrow, to prevent spinning-off by persons who are conscious of their thin eyebrow, or who have lost a part or a whole of their eyebrows by injury, burn, etc.

95 CLAIMS

1. An electrotherapeutic apparatus, comprising:
 - (a) an active electrode;
 - (b) a dispersive electrode;
 - (c) a single plate member supporting said active and dispersive electrodes;
 - (d) a flexible belt attached to both ends of the plate member,
 - (e) an oscillator generating an electrotherapeutic current having a diphasic alternating potential superposed on a pulsating current; and
 - (f) a dc source for supplying the apparatus,
- 100 wherein said active and dispersive electrodes are energized by said electrotherapeutic current such that the potential at the active electrode is sufficiently higher than that at the dispersive electrode that iontophoresis of an aminovinyl photosensitizing dye is effected.

2. An apparatus as claimed in Claim 1, wherein said aminovinyl photosensitizing dye is 6 - [2 - [(5 - bromo - 2 - pyridyl)amino]vinyl] - 1 - ethyl - 2 - picolinium iodide.

3. An apparatus as claimed in Claim 1, or 2, wherein said pulsating current is a square or a trapezoidal wave.

4. An apparatus as claimed in any preceding claim, wherein said diphasic alternating potential and the pulsating current are respectively generated by a blocking oscillator and by a multivibrator.

5. An apparatus as claimed in any preceding claim, wherein the period of said diphasic

seconds and the period of the pulsating current is in the range 0.5—2 seconds.

as hereinbefore described with reference to the accompanying drawings.

6. An electrotherapeutic apparatus substantially

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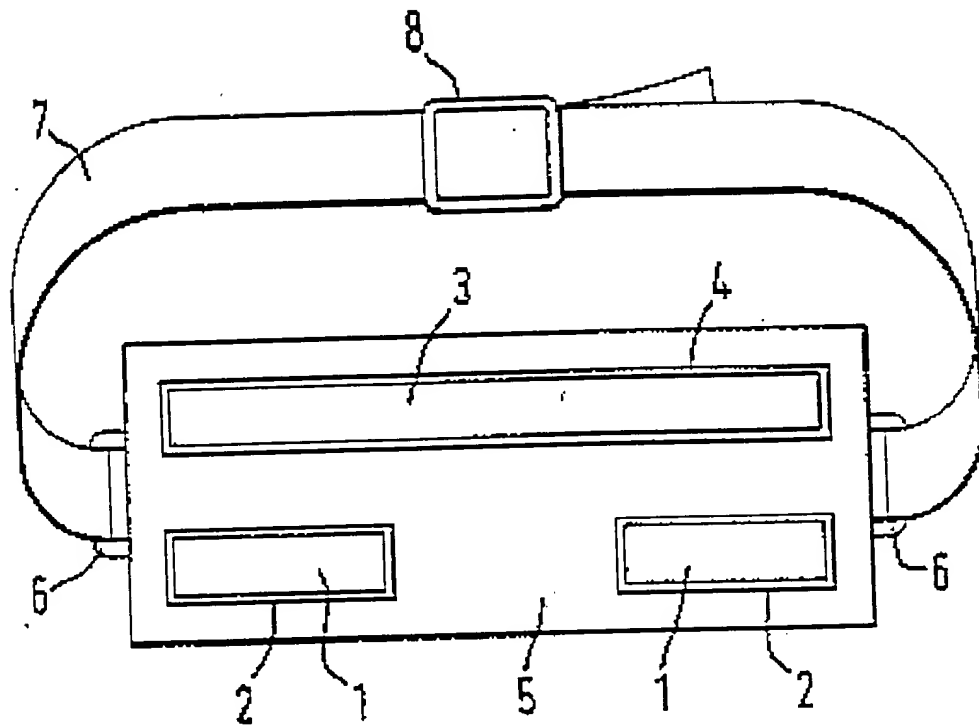


FIG.1

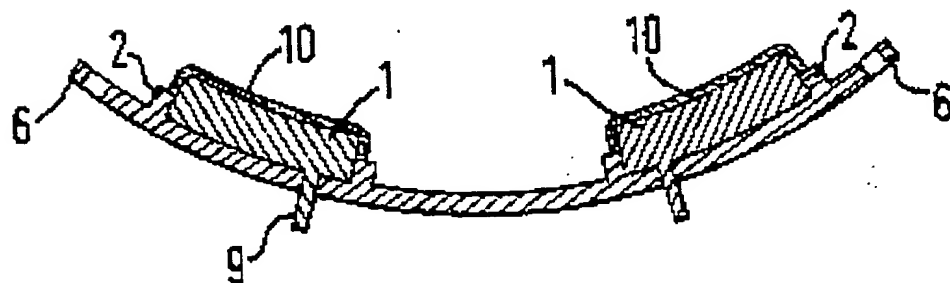


FIG.2

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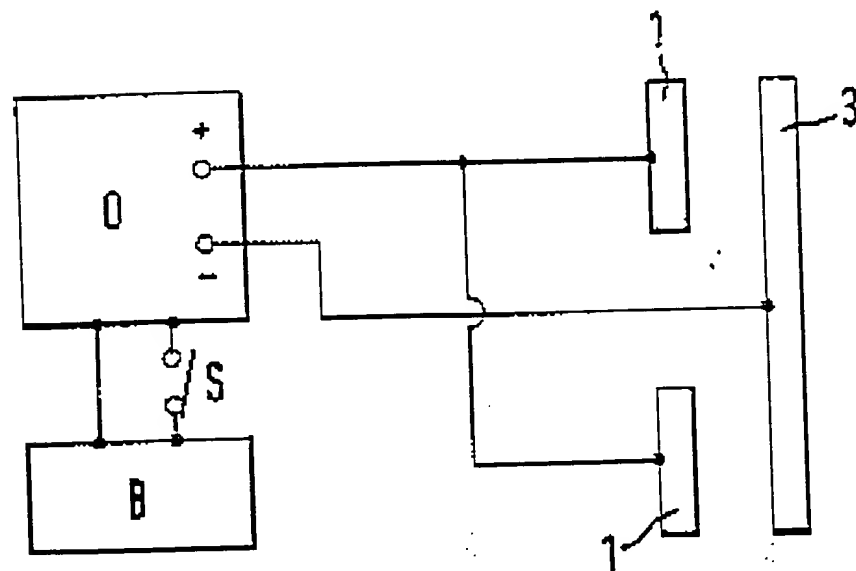
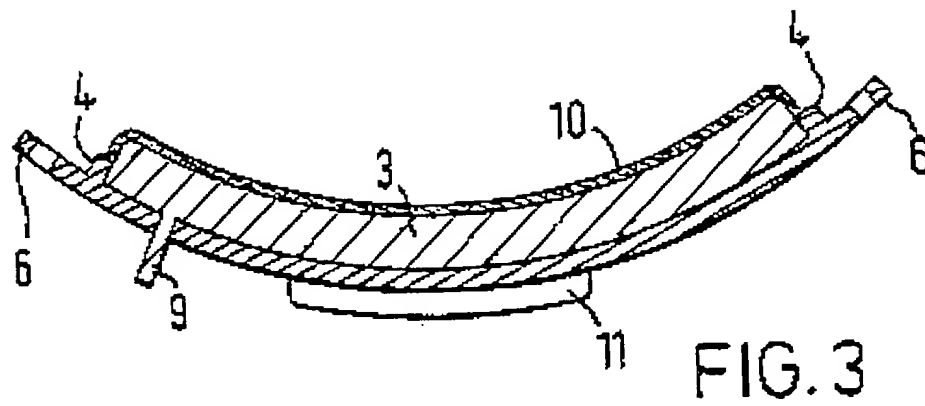


FIG. 4

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